

3/5

# (12) UK Patent Application (19) GB (11) 2 355 876 (13) A

(43) Date of A Publication 02.05.2001

(21) Application No 0004480.0

(22) Date of Filing 26.02.2000

(30) Priority Data

(31) 9925140

(32) 25.10.1999

(33) GB

(71) Applicant(s)

**Roke Manor Research Limited**  
(Incorporated in the United Kingdom)  
Old Salisbury Lane, ROMSEY, Hampshire, SO51 0ZN,  
United Kingdom

(72) Inventor(s)

**Richard John Evans**  
**Anthony St John Michael Dixon**  
**Edmund Peter Sparks**  
**Christopher George Harris**

(51) INT CL<sup>7</sup>

G01S 3/786 1/06 13/86

(52) UK CL (Edition S )

H4D DLAA D773 D774 D781 D782

(56) Documents Cited

GB 2250653 A EP 0899580 A2 EP 0813040 A2  
WO 98/08208 A2 WO 88/00747 A2 JP 090188248 A

(58) Field of Search

UK CL (Edition R ) H4D DAA DLAA  
INT CL<sup>6</sup> G01S 1/06 3/786 13/86 13/87  
ONLINE: WPI, EPODOC, JAPIO

(74) Agent and/or Address for Service

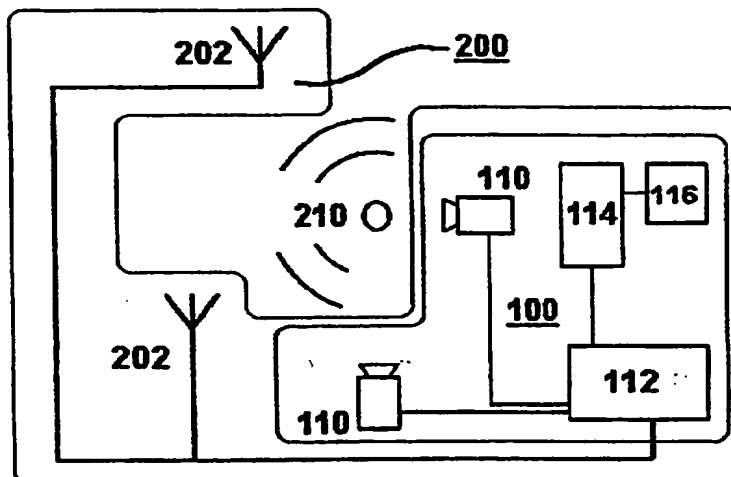
**Derek Allen**  
**Siemens Shared Services Limited,**  
**Intellectual Property Department, Siemens House,**  
**Oldbury, BRACKNELL, Berkshire, RG12 8FZ,**  
**United Kingdom**

(54) Abstract Title

**Location and tracking system.**

(57) A first apparatus, 202, detects the approximate location of an object, 210, and a second locator, 110, uses this information to track the object. The system may use radio tags attached to an item as the first means, and then track the object using a video camera. A locating signal may be emitted by the first location apparatus. The system may be a surveillance camera which tracks a customer in a shop once that person has picked up an item, basket or perhaps the identification tag could be their store loyalty card.

In a second embodiment, the position of an item is monitored at intervals and when movement is detected an image retrieval device is directed to the area. These images may be stored, 116, for later analysis by a central processor, 114, which may be a switching matrix, 112. The locator tag may be battery powered.



**Figure 2**

FP03-0292  
-00EP-AR  
05.1.18  
SEARCH REPORT

GB 2 355 876 A

1/2

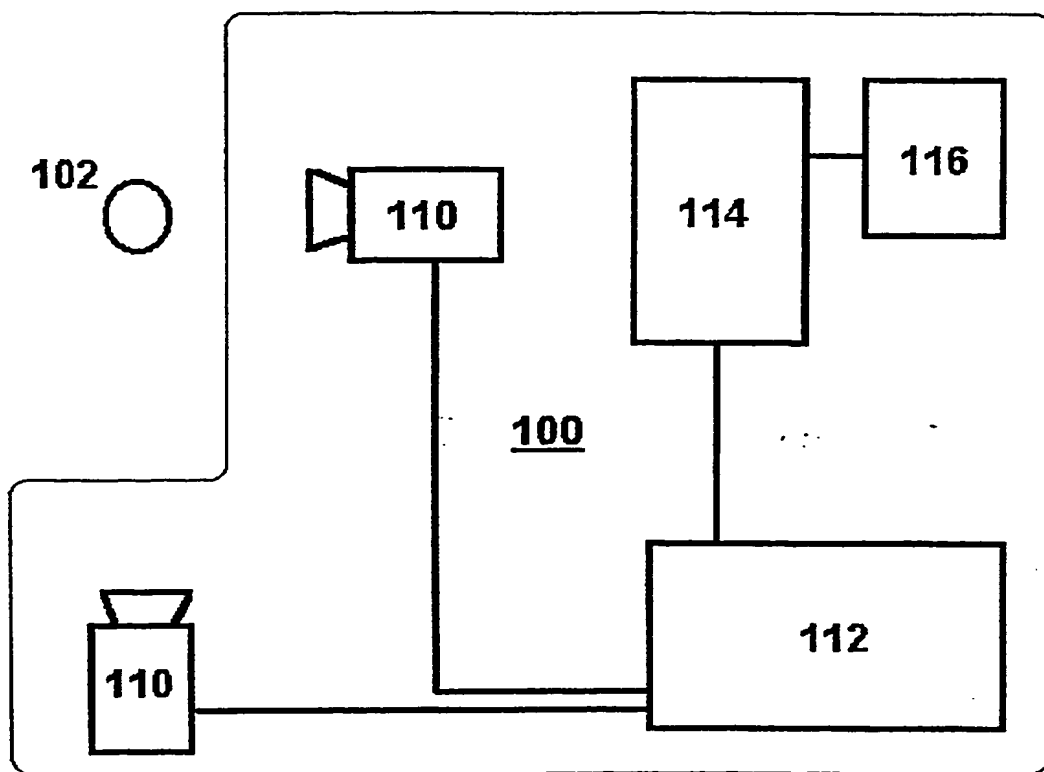


Figure 1

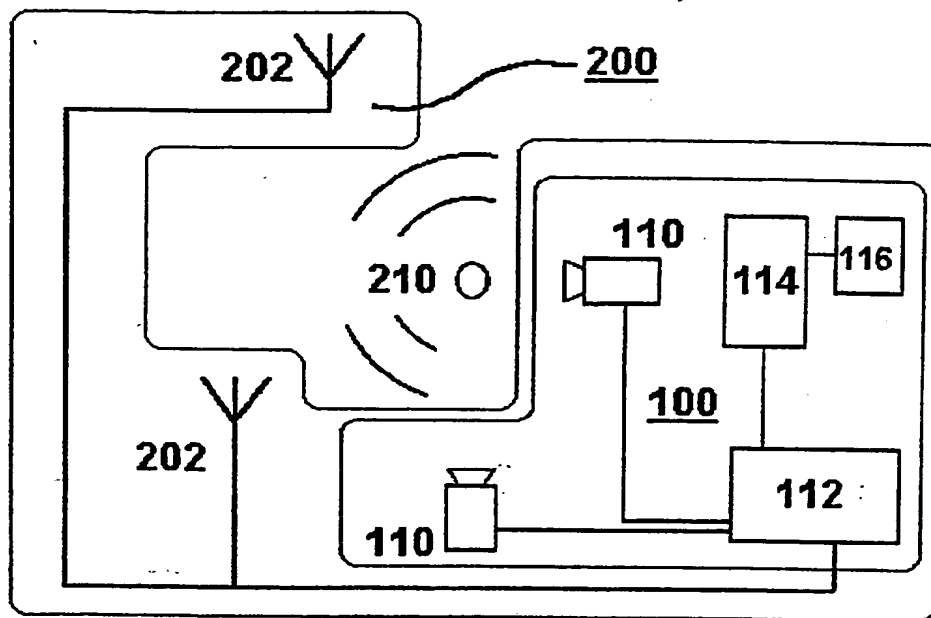


Figure 2

## LOCATION AND TRACKING SYSTEM

The present invention relates to a system for locating and tracking a person or a moveable article. More particularly, the system requires the association of a locator tag to the moveable article or with the person.

It is desirable to be able to detect, locate and track both the positions and the changes in position of people and goods or other articles within a monitored area, such as a retail establishment.

In accordance with the present invention, there is provided a locating and tracking system including a first locating apparatus and a second locating apparatus, the first locating apparatus gives an approximate location of an item and the second locating apparatus uses the approximate location given by the first locating apparatus to track the item.

Preferably, the first locating apparatus detects and locates a locator tag which is associated with the item.

Preferably, the locator tag emits a location signal, the first location apparatus detects the location signal and calculates the approximate location of the locator tag from the characteristics of the detected location signal. Even more preferably, the location signal is a characteristic radio frequency signal and the first location apparatus is a radio frequency detection system.

Equally preferably, the first locating apparatus emits a detection signal, the locator tag reflects the detection signal, the first locating apparatus receives the reflected detection signal and calculates the approximate location of each locator tag from the characteristics of the reflected detection signal. More preferably, the detection signal is a radio frequency detection signal and the first location apparatus is a radio frequency detection system.

Preferably the first locating apparatus includes a processing device and the processing device performs the calculation of the approximate location.

Advantageously, the second locating apparatus includes an imaging system and the second locating apparatus tracks the item by directing the imaging system towards the approximate location. Preferably, the imaging system includes at least one image retrieval device coupled to a central processing and control apparatus. The central processing and control apparatus is coupled to an image storage apparatus via an image processing apparatus.

More preferably, the approximate location from the first locating apparatus is used by the central processing and control apparatus to direct the at least one image retrieval device towards the item. It is preferable that the imaging system is a video surveillance system and the at least one image retrieval device is a video camera and more preferable that the approximate location is only used to direct the at least one image retrieval device when the first locating apparatus indicates that the location of the item has changed.

Preferably, the image processing apparatus processes images of activity in the neighbourhood of the item. More preferably, the image processing apparatus stores the processed images of activity in the neighbourhood of the item.

The central processing and control apparatus is preferably a switching matrix.

In operation, the locating and tracking system preferably tracks a locator tag, and any item to which the locator tag is attached, as follows: detecting the presence of the locator tag; at regular intervals, calculating the location of the locator tag; detecting when a change in location of the locator tag has occurred; responding to the change in location by generating

instructions for an image retrieval device; and directing the image retrieval device to retrieve image data which covers the location.

Preferably, the operation of the locating and tracking system further includes: using an image processing apparatus to process the image data in order to provide an image of the neighbourhood of the locator tag and to enable subsequent tracking of the locator tag; and selectively storing the processed image data for later scrutiny.

When a locator tag is used by the locating and tracking system, the tag is arranged to be detected, located and tracked by the first locating apparatus. Preferably, the locator tag is associated with an item or a person. Preferably, the locator tag has at least one battery. More preferably the locator tag emits a location signal. Alternatively, the locator tag can be passive and have no need for battery-power. Preferably, the locator tag is then arranged to reflect a detection signal.

For a better understanding of the present invention, reference will now be made, by way of example only, to the accompanying drawings in which:-

Figure 1 shows a schematic diagram of a video surveillance system; and Figure 2 shows a schematic diagram of an embodiment of the locating and tracking system of the invention.

Referring to Figure 1, an image of an item or person 102 can be captured by a video surveillance system 100. The video surveillance system 100 comprises a plurality of video cameras 110 coupled to a central processing and control apparatus, known as a switching matrix 112. The switching matrix 112 is coupled to an image storage apparatus 116 via an image processing apparatus 114. Captured images can be processed by the image processing apparatus 114 and stored by the image storage apparatus 116 for later scrutiny.

A first embodiment of the present invention requires the presence of a radio frequency (rf) locator tag as shown in Figure 2. A location and tracking system 200 detects, locates and tracks an rf locator tag 210 and thereby any article or person associated with the rf locator tag 210. The  
5 detection of movement of the rf locator tag 210 within the detection range of an rf locating apparatus 202 triggers a video surveillance system 100 as illustrated in Figure 1 to capture images of the vicinity of the rf locator tag 210. The location and tracking system 200 can thus be used to track the movements of customers within a retail establishment, for example a shop,  
10 a supermarket or a shopping mall.

The rf locator tag 210 can be fitted to an item used within the retail establishment, for example a shopping trolley, shopping basket, or a handheld self-scan device, in which case the locator tag is provided with a battery arrangement. In this case, the rf locator tag emits a characteristic rf  
15 signal at regular intervals. The rf locating apparatus 202 detects the rf signal and locates the source of the rf signal.

Alternatively, a lighter, passive rf locator tag can be implemented upon a card, a store loyalty card for instance. The passive rf locator tag requires no battery arrangement and is more appropriate for tracking and  
20 detection over short ranges. For a passive locator tag to function, the rf locating apparatus 202 must broadcast an rf signal at predetermined intervals. The rf signal either reflects from the passive rf locator tag or briefly activates circuitry embedded in the passive rf locator tag. The passive rf locator tag then reflects or emits an rf response signal. The rf  
25 response signal is detected and the source of the rf response signal is located.

With or without battery arrangement, the rf locator tag 210 allows a given customer to be tracked around the retail establishment; the initial detection and location being performed by the rf locating apparatus 202 and

the subsequent tracking being performed by the video surveillance system 100. The rf locating apparatus 202 can also be used in the subsequent tracking stages in order that the video surveillance system 100 continues to receive updated location information. This updated information can be helpful when the given customer is hidden from view of the video cameras 110.

In subsequent tracking, the captured images of a given customer are image processed and stored. Valuable information for marketing purposes can be garnered by monitoring the time spent by the given customer in different areas of the retail establishment and the route taken by the given customer. Thus, for instance, the paths of a plurality of monitored customers can be overlaid to show where the customers have passed, how many times they passed and how long they spent in passing.

Additionally, evidence that a given customer was in a particular area of a retail establishment is often of value for security purposes, for example in order to detect whether the given customer was shoplifting. In security applications, the location and tracking system 200 can be arranged to control video cameras 110 in order to selectively record events of interest such as suspicious movement patterns and the movements of a suspect around the retail establishment.

The location and tracking system 200 of the present invention can also be used in a slightly different way, to track a given item. The rf locator tag 210 is attached to a retail item, for example, a DVD player or a bottle of spirits; the item can then be tracked around a retail establishment. Again, as the position of the rf locator tag 210 changes, the rf locating apparatus 202 triggers the operation of the video cameras 110 of the video surveillance system 100. Alternatively, position changes detected by the rf locating apparatus 202 can be provided as indexing information for the switching matrix 112 controlling the cameras 110, so that events which are



potentially of more interest are marked out for later scrutiny. The rf locator tag 210 for tracking retail items can be of a passive or a battery-powered type.

The location and tracking system 200 of the present invention may serve many independent purposes at the same time. In addition to the provision of marketing information to show where a given customer or retail item moves in a retail establishment, the location and tracking system 200 can simultaneously be used in fraud detection, personal security and building security applications.

Changes in locator tag position, movement of locator tags into or out of a predetermined area or suspicious movement of locator tags (for example movement of locator tags within a restricted area) can act as trigger events for further tracking system processes, including video camera control and image processing of selected video signals. For example, a trigger event can cause: the image processing apparatus 114 to begin processing signals from a given camera 110; the image storage apparatus 116 to begin recording; or a given camera 110 to move to cover a particular area. The video signals from a number of video cameras 110 can be accessed by the switching matrix 112. The tracking of the locator tags 210 and the triggering of selective image processing and recording of events may be co-ordinated at the switching matrix 112. Different types of locator tag movement are of interest in different applications and the precise manner of triggering and image processing can be tailored to according to the application.

In a second embodiment of the present invention, the video cameras 110 themselves can be used to detect trigger events. In other words the first and second locating systems are one and the same system. The movement of an item can be determined by image processing the video signals from the video cameras 110.

It will be understood that the location tag detecting device can be arranged to detect and locate a plurality of locator tags, irrespective of whether these locator tags are battery-powered or battery less.

While the preceding description is concerned with a video  
5 surveillance system, it should be understood that the invention can be implemented using any suitable cameras of known type, for example cameras which operate on infrared images, moving picture cameras, web cameras or stills cameras. The cameras of the invention can be moveable mounted or fixed, as is known in the art. Fixed cameras can have fisheye  
10 lenses in order to have a 360° field of view and a portion of the fisheye image corresponding to the vicinity of an event of interest can be image processed.

**Claims:**

1. A locating and tracking system including a first locating apparatus and a second locating apparatus, the first locating apparatus gives an approximate location of an item and the second locating apparatus uses the  
5 approximate location given by the first locating apparatus to track the item.
2. A locating and tracking system as claimed in Claim 1, wherein the first locating apparatus detects and locates a locator tag which is  
10 associated with the item.
3. A locating and tracking system as claimed in Claim 2, wherein the locator tag emits a location signal and wherein the first location apparatus detects the location signal and calculates the approximate location of the  
15 locator tag from the characteristics of the detected location signal.
4. A locating and tracking system as claimed in Claim 3, wherein the location signal is a characteristic radio frequency signal and the first location apparatus is a radio frequency detection system.  
20
5. A locating and tracking system as claimed in Claim 2, wherein the first locating apparatus emits a detection signal, the locator tag reflects the detection signal, the first locating apparatus receives the reflected detection signal and calculates the approximate location of each locator  
25 tag from the characteristics of the reflected detection signal.

6. A locating and tracking system as claimed in Claim 5, wherein the detection signal is a radio frequency detection signal and the first location apparatus is a radio frequency detection system.

5 7. A locating and tracking system as claimed in any one of Claims 3 to 6, wherein the first locating apparatus includes a processing device and wherein the calculation of the approximate location is performed by the processing device.

10 8. A locating and tracking system as claimed in any one of Claims 1 to 7, wherein the second locating apparatus includes an imaging system and wherein the second locating apparatus tracks the item by directing the imaging system towards the approximate location.

15 9. A locating and tracking system as claimed in Claim 8, wherein the imaging system includes at least one image retrieval device coupled to a central processing and control apparatus, the central processing and control apparatus being coupled to an image storage apparatus via an image processing apparatus.

20

10. A locating and tracking system as claimed in Claim 9, wherein the approximate location from the first locating apparatus is used by the central processing and control apparatus to direct the at least one image retrieval device towards the item.

25

11. A locating and tracking system as claimed in Claims 9 or 10, wherein the imaging system is a video surveillance system and the at least one image retrieval device is a video camera.

12. A locating and tracking system as claimed in Claims 9, 10 or 11, wherein the approximate location is only used to direct the at least one image retrieval device when the first locating apparatus indicates that the location of the item has changed.

5

13. A locating and tracking system as claimed in any one of Claims 9 to 12, wherein the image processing apparatus processes images of activity in the neighbourhood of the item.

10 14. A locating and tracking system as claimed in Claim 13, wherein the image processing apparatus stores the processed images of activity in the neighbourhood of the item.

15 15. A locating and tracking system as claimed in any one of Claims 9 to 14, wherein the central processing and control apparatus is a switching matrix.

16. A method of locating and tracking an item, the method consisting of the following steps:

- 20 a) detecting the presence of the item;  
b) at regular intervals, calculating the location of the item;  
c) detecting when a change in location of the item has occurred;  
d) responding to the change in location by generating instructions for at least one image retrieval device; and  
25 e) directing said at least one image retrieval device to retrieve image data which covers the location.

17. A method as claimed in Claim 16, wherein the item includes a locator tag and wherein the presence of the item is disclosed by detection

of the locator tag, the location of the item is calculated from the location of the locator tag and the change in location of the item corresponds to a change in location of the locator tag.

5 18. A method as claimed in Claim 17, further including the following steps:

f) using an image processing apparatus to process the image data in order to provide an image of the neighbourhood of the locator tag and to enable subsequent tracking of the locator tag; and

10 g) selectively storing the processed image data for later scrutiny.

19. A locator tag which is arranged to be detected and located by the first locating apparatus of the location and tracking system of Claim 1.

15 20. A locator tag as claimed in Claim 18, wherein the locator tag associated with an item.

21. A locator tag as claimed in Claims 18 or 19, the locator tag having at least one battery.

20

22. A locator tag as claimed in Claim 20, the locator tag emitting a location signal.

23. A locator tag according to Claims 18 or 19, the locator tag being  
25 arranged to reflect a detection signal broadcast by the first locating apparatus.

24. A locator tag substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.

25. A locating and tracking system as claimed in Claim 1, wherein the first locating apparatus is a video surveillance system and uses image processing to generate an approximate location.

5

26. A locating and tracking system as claimed in Claims 1 or 24, wherein the second locating apparatus is the same physical apparatus as the first locating apparatus.

10 27. A locating and tracking system substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.



Application No: GB 0004480.0  
Claims searched: 1-15

Examiner: Robert Shorthouse  
Date of search: 8 September 2000

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H4D (DAA, DLAA)

Int Cl (Ed.7): G01S 1/06, 3/786, 13/86, /87

Other: Online: WPI, EPODOC, JAPIO

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2250653 A (SIEMENS) See abstract	1, 8-10
X	EP 0899580 A2 (KABUSHIKI) See column 2 lines 14-33	1, 8-11, 13, 14
X	EP 0813040 A2 (XEROX) See column 2 line 49- column 3 line 22, lines 43-47	1-3, 5
X	WO 98/08208 A2 (FOOTFALL) See page 1 line 25 - page 2 line 20 and page 5 line 8 -18	1, 2, 8-14
X	WO 88/00747 A2 (DENNING) See page 4 paragraph 6 - page 5 paragraph 3	1, 8-10, 12-14
X	JP 090188248 (HITACHI) See PAJ abstract	1, 8-11

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.